The Journal of Animal and Plant Sciences, 22(2 Suppl.): 2012, Page: 87-91
ISSN: 1018-7081

EFFECT OF PREGNANCY ON BODY HAIR GROWTH IN DAIRY CATTLE

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ABSTRACT

Pregnancy is a dynamic state associated with a number of hormonal changes. Present study reports the effect of pregnancy and parturition on body hair growth in dairy cattle. For this purpose Holstein Friesian cows, three early pregnant and two post-parturition were used. The hairs samples from neck, thoracic and back areas were collected twice a week for a period of two months to measure hair weight and the diameter. An increase in hair diameter and weight with advancing days of pregnancy was observed, whereas the hair weight decreased after parturition. In pregnant cows, a persistent increase of diameter and weight along the individual fibers from tip to end was observed. Furthermore, a similar pattern of increase in weight and diameters was also observed for the neck thoracic and back hairs. A positive and significant correlation between hair fiber diameter and weight was observed in pregnant cows. These results indicated that the hair growth is affected by the pregnancy status in dairy cattle.

Key words: Pregnancy, body hair, hair diameter, fiber weight and dairy cattle.

INTRODUCTION

Pregnancy is a dynamic state associated with complex sequence of physiological phenomena in dairy cattle. Monitoring of the information on the physiological status during pregnancy is, therefore, essential for improving the well being in dairy cattle management (Kindahl et al. 2002).

It has been reported that the physiological parameters during pregnancy can be monitored using a variety of parameters, such as blood thyroid hormone in human (Glinoer, 1997), milk progesterone in buffalo (Khan et al. 2009). Furthermore, current technology allows to visually diagnosing pathological changes, such as polycystic ovarian syndrome during pregnancy (Ben-Chetrit and Greenblatt, 1995). Therefore, it is considered that the overall animal well-being can be improved by integrating information on the physiological and pathological status of the pregnant dairy cows.

Body hair is important component of the integument system which primarily serves to protect the body. It has been reported that hair growth is influenced by the hormonal status in sheep (Furguson et al 1965) and in human (Ebling et al 1990). The physiological status is reported to change during pregnancy in human skin (Mem, 2006). Scapl hair diameter is reported to increase during pregnancy in human (Nissimov and Elchalal, 2003). However, information on the effect of pregnancy on the hair growth has not been reported in cattle.

Present study, therefore, was conducted to examine the effect of pregnancy on body hair growth associated with of pregnancy in dairy cattle.

MATERIALS AND METHODS

Experimental Animals: Five Holstein Friesian cows, three early pregnant (ID165, ID176, ID180) and two post-parturition (ID173 and ID174), maintained at Agricultural and Forestry Research Center, University of Tsukuba, Japan were used in the present study (Table 1). All animal care and handling procedures were performed in accordance with the standards of the University of Tsukuba.

Hair Samples Collection and processing: A bunch of about 80-100 hairs each was collected from the three different sites on vertebral column; including cervical region (between occipital bone and the last cervical vertebra), thoracic region (From first thoracic vertebra to last rib) and back region (from last rib to hip points). The hair samples were collected in plastic bottle, labeled with animal number, sampling date and region from which the hair was collected. The cows were sampled for hair twice a week for a period of two months.

Before processing the hair samples for micrometry, representative hair fibers having intact root and length of 1.5cm or more were sub sampled from all the samples. Ten hair fibers were randomly selected from each sub sample for further processing. Separate weight of each fiber was determined using a sensitive balance. The diameter of hair sample for its root, center (0.75cm from root) and tip (1.5 cm from root) was measured by using micrometer attached to microscope.

Statistical Analysis: Logarithmic regression and linear regression was performed using SAS (SAS).

RESULTS

Changes in the ratio of hair thickness and hair weight in pregnant Holstein cows are shown in Fig 1. The thickness of the body hair differed considerably among pregnant cows. Therefore, ratio was calculated by using thickness of hair sample during sampling period as nominators and thickness at initial day of observation as a denominator. Regression coefficient and coefficient of determination (R2), as calculated by logarithmic regression, for the thickness of bottom, center and tip of the neck hair were, 0.3481and 0.87, 0.2237 and 0.83, and 0.2369 and 0.84, respectively. Regression coefficient for thoracic hair and back hair showed similar tendency with neck hair (data not shown). A significant thickening of the body hair were observed in neck, thoracic and back hair (P<0.05), but no significant differences were observed between bottom, center and tip of the hair.

Regression coefficient and coefficient of determination for the weight of neck, thoracic and back hair were, 0.3788 and 0.8617, 0.5457 and 0.8502, and 0.5092 and 0.833, respectively. A significant increase of the body hair weight was observed in neck, thoracic and back hair (P<0.05), but no significant differences were observed between them. Correlation coefficient between hair thickness and hair weight of neck, thoracic and back hair in pregnant cows were 0.956, 0.937, and 0.937, respectively

Postpartum changes of hair thickness: As shown in Figure 2, body hair thickness tended to decrease after parturition, but significant decrease in body hair thickness was observed only at bottom part of the neck hair (regression coefficient = -0.0167, R2= 0.7635). Regression coefficient and coefficient of determination for the weight of neck, thoracic and back hair were, -0.0174 and 0.8382, -0.0167 and 0.8341, and -0.0151 and 0.6912, respectively. A significant decrease of the body hair weight was observed in neck, thoracic and back hair (P<0.05), but no significant differences were observed between them. Correlation coefficient between hair thickness and hair weight of neck, thoracic and back hair in post-partum cows were 0.577, 0.646, and 0.053, respectively.

Table 1 Experimental animals and their description

Id	Age (Month)	Parity	Days after Pregnancy/Parturition
165	60.3	3	47 (Preg)
176	30.5	2	1 (Preg)
180	48.1	0	37 (Preg)
173	37.8	1	1 (Part)
174	35.7	1	35 (Part)

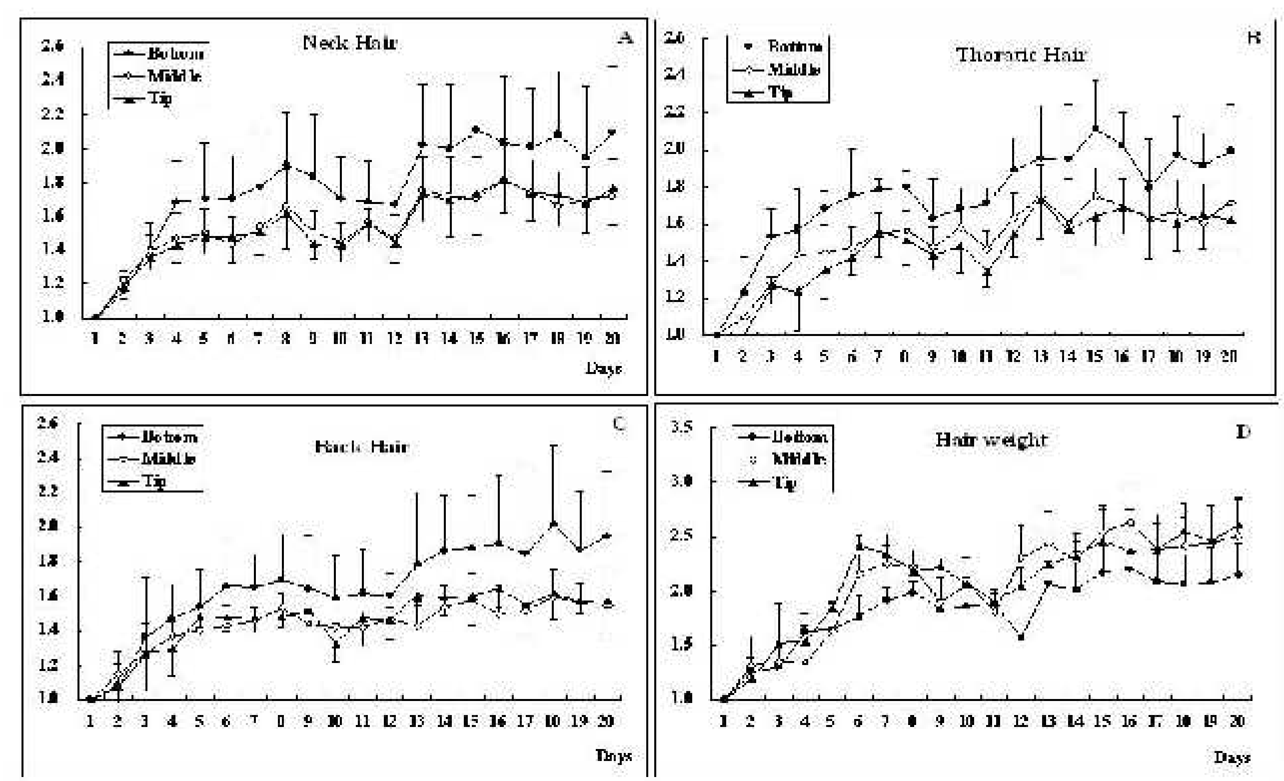

Figure 1. Change in hair diatmeter (A, B and C) and weight (D) with pregnancy

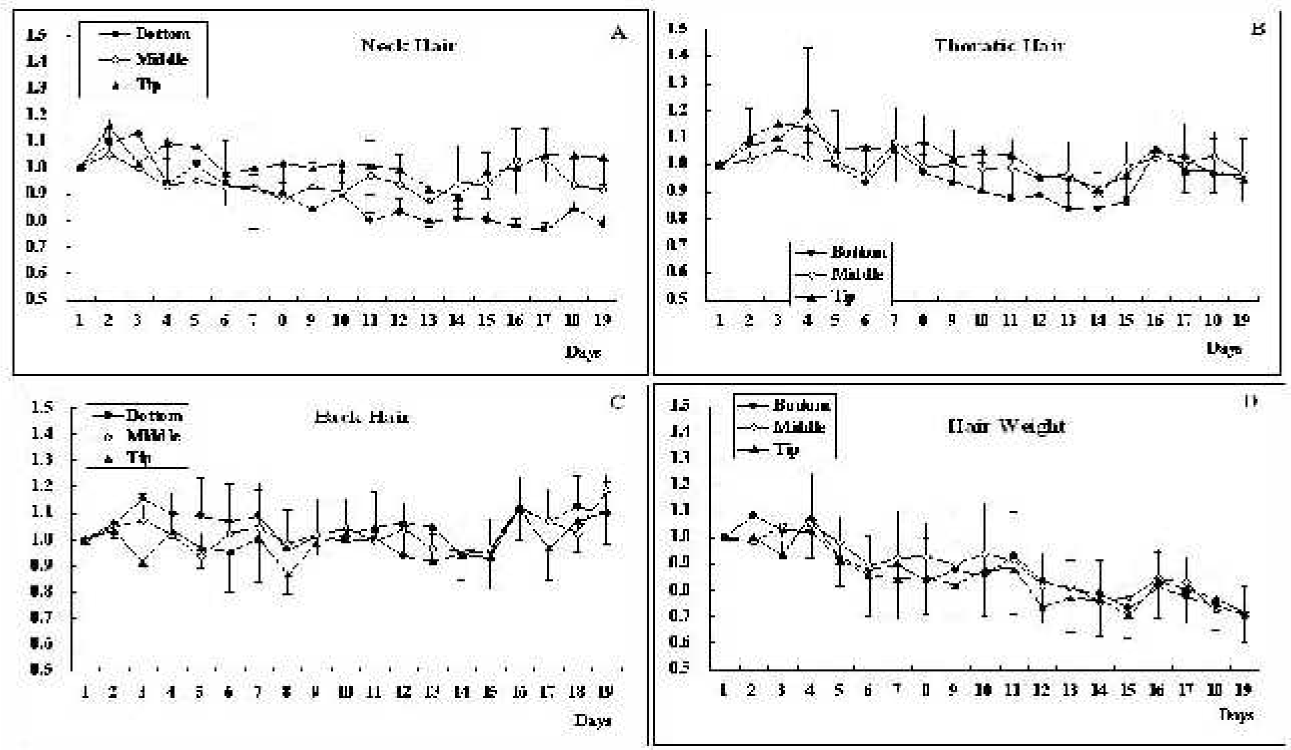

Figure 2. Change in hair diatmeter (A, B and C) and weight (D) with post partum days

DISCUSSION

An increase in hair diameter and fiber weight with advancing days of pregnancy and a reverse of these after parturition were observed in present study. Pecoraro et al. (1990) reported the increased proportion of thick to medium and thin hairs during pregnancy and correlated this to diameter changes. Later Nissimov and Elchalal (2003) reported that major –axis diameter increased towards the scalp in hair from pregnant women at the start of pregnancy with a 0.58% slop rate. These changes in body hair with pregnancy can be described by several general concepts.

Pregnancy hormones and hair: Pregnancy hormones lead to make the body hair grow faster and thicker. Wallec et al., (1998) reported that during pregnancy hair growth is increased, as estrogen appears to prolong the anagen phase. However, postpartum hair loss is common, and this may be related to a decrease in estrogen and or progesterone levels. If the hairs are growing fast and thick, one can thank the increased amount of estrogen in the body. Estrogen sends a signal to hair follicles that they need to get growing and stop shedding (Stenn and Paus 2001). Increased estrogen also speeds up metabolism, which brings nutrients to scalp as well as to growing fetus (Stenn and Paus 2001). Slobodan and Snezana (1998) reported that Androgens indirectly control hair growth by influencing the synthesis and release of cytokines from the dermal papilla cells. Thyroid hormone also affects hair growth in animals and human beings (Beek et al., 2008). In rats thyroxin increases and thiouracil decreases the final length of hair (Ebling, 1990).

Pregnancy, nutrients and hair: Pregnancy is a dynamic anabolic state associated with many adjustments in nutrients metabolism. These adjustments in nutrient metabolism are apparent within the first weeks of pregnancy (Haytten and Chamberlain, 1980). After the first 10 wk of pregnancy, serum triacylglycerol concentrations in pregnant women were 20% higher than those of non pregnant women (King, 2000). Other serum lipids (ie, phospholipids, cholesterol, glycerol, and fatty acids) also increase during pregnancy (King, 200). The net increase in plasma volume rises from 50 ml at 10 wk gestation to 800 ml at 20 wk gestation (Okojie et al., 2011). Although the concentration of nutrients in the circulation declines during the same period of time, the reduction is less than the 40-fold change in plasma volume (King, 2000). Thus, the total amount of vitamins and minerals in circulation increases during pregnancy (Okojie et al., 2011). Approximately 3.3 kg fat is deposited in maternal stores, providing an energy reserve of <30 000 kcal (129 MJ); the remaining 0.5 g fat is deposited in the fetus (King, 2000). A greater rate of nitrogen retention than the predicted need led investigators to propose that the mother gains additional protein in her own tissues (King, 2000). Naismith (1973) found that dams gained enough protein during the first 2 wk of pregnancy to increase maternal lean body mass by 8%. The above discussion favors the elevation of body nutrients pool by either mean (internal or external adjustment) with the onset of pregnancy. The hair follicles are metabolically active tissues and require nutrients to support both structural and functional activities (Galbraith,1998). As such, nutrition has a profound effect on both its quality and quantity. Hence these post conception changes in the body reserves may accomplish the increase in hair thickness and weight. Poor nutrition may lead to produce dull, dry, brittle, or thin hair coat. Similarly pigmentary disturbances may also occur. Nutritional factors that influence hair growth are very complex and can be interrelated. Those most commonly associated with poor hair quality and hair loss have been summarized by Lewis (1995). They comprise dietary deficiencies of protein, phosphorus, iodine, zinc, and vitamins A and E, as well as dietary excesses of selenium, iodine, and vitamin A. It is clear from the above discussion that after parturition when the nutrients are prioritized for milk production the supply to hair may be reduced and thus the hair diameter and weight postpartum may have reduced.

Hair growth Phases and pregnancy: Lynfield, (1960) reported that pregnancy hormones maintain follicles in anagen phase. But after birth they enter catagen and telogen causing synchronized partial shedding or molt. Randall, (2000) termed estrogen and prolactin as possible cause of keeping hair in anagen phase during pregnancy. Presence of receptors for both prolactin (Fiotzik et al., 2006) and 7B-oestradiol (Thoronton et al., 2003) in human hair follicle have already reported. Other hormones implicated in regulating hair growth cycles include the sex steroids, oestradiol and testosterone, and the adrenal steroids; these delay anagen in rats Ebling et al., (1991). It is evident from the above findings that hair during pregnancy remain in anagen phase where hair follicles have profuse blood supply (abundant supply of required nutrients) leading to increase in hair diameter and fiber weight. As the pregnancy terminates the hair inter to catagen phase where the blood supply to the follicle is almost ceased and this results into shrinkage in hair thickness and loss of fiber weight.

Pregnancy vascularity and hair: Throughout pregnancy, there is a proliferation of blood vessels reflected by a variety of clinical manifestations, most of which subside spontaneously after parturition. The increased vascularity during pregnancy is largely due to new capillary networks in the dermis and hypodermic mass (Maya et al., 2006). The most extensive capillary network is found around the lower half or third of the follicle (Stenn and Paus 2001). This external supply to the follicle wall is of far greater extent than the internal supply to the follicle papilla, and it is possible that the external root sheath reacts with this capillary system, adding to or removing substances from the blood before this passes through the papillary vessels. Before the onset of pregnancy the circulation about the follicle wall is very much less extensive maintaining the fiber in its normal size (Beek et., 2008). However after conception the follicle gets the most extensive capillary system. The distribution of capillary vessels corresponds approximately with that of the supposed phosphatase activity in the papilla and the follicle wall (Stenn and Paus 2001). The hair fiber during growth phase contain a considerable bulk of keratin, and a most reasonable explanation of the extensive circulation to the follicle wall would be that it is associated with the synthesis of intracellular protein in the hair cuticle and cortex (Duraward and Rudall,1949). According to Johnson, Butcher and Bevelander (1945) the papilla markedly alters its shape during the catagen phase (Dry, 1925), becoming narrow and elongated. On such a view the reduced phosphatase activity of the papilla at the catagen phase may represent the reduction or degeneration of its capillaries. This could better explain the post partum reduction in hair diameter and fiber weight. Present study reports the higher diameter and weights of the neck hair fibers as compared to the hair fibers from thoracic and back. Randall, (2007) presumed that the regional contrast of hair growth may be due to differential gene expression within individual follicle. Pan (1964) investigated variation in hair characters over the body coat in Sahiwal and Zebu Jersy cattle. He reported an increase in fiber diameter and length towards posterior. The contradiction with his findings may be due to the breed and climatic difference of the experimental animals.

Present results indicated that the notable changes in hair weight and diameter with the onset of pregnancy and or parturition are seen after four to five weeks. Similar to the present findings Metwalli et al. (1977) reported that the protein contents of hair was diminished in the protein deficient rate after four weeks followed by a gradual decrease till the end of the experiment. If present findings could have the back up from extensive field study these can be used for developing the new technology for diagnosis of pregnancy through the use of body hair.

Conclusions: This study suggests that the hairs become thicker and heavier with pregnancy. The hair becomes thinner and lighter after parturition. These changes in hair may be associated with changes in hormonal status due to pregnancy, which may help in developing a quick test for pregnancy diagnosis in dairy cattle.

Acknowledgment: HEC of Pakistan provided financial support and staff of Ag for Res Center, helped in lab analysis.

REFERENCES

Ben-Chetrit, A. and E. M. Greenblatt. (1995). Recurrent maternal virilization during pregnancy associated with polycystic ovarian syndrome: a case report and review of the literature. Human Reprod. 10: 3057–3060.

Dry, F. W. (1925). The coat of the mouse (Mus musculus). J. Genetics. 16: 287-340.

Durward, A. and Rudall, K. M. (1949). Studies on hair growth in the rat. J. Anatomy. 83: 32S-33S

Ebling, F. J. G., (1990). The Hormonal control of Hair growth. In: Hair and Hair Diseases. eds Orfanos and R. Happle Berlin Springer Verlag; 267-299.

Ebling, F. G., P. A. Hale and V. A. Randall. (1991). Hormones and hair growth. In: L.A. Goldsmith, Editor, Biochemistry and physiology of the skin (2nd ed.), Oxford: Clarendon Press; 660–690.

Ferguson, K. A., A. L. Wallace and C. Lindner, (1965). Hormonal regulation of wool growth. In: A. G. Lyne and B. F. Short (ed.) Biology of the Skin and Hair Growth, 655–665.

Fiotzik, K., K. Krause, F. Conrad, M. Nakamura, W. Funk and R. Paus. (2006). Human scalp hair follicles are both a target and a source of prolactin, which serves as an autocrine and/or paracrine promoter of apoptosis-driven hair follicle regression. American J. Pathol.168: 748–756.

Galbraith, H., (1998). Nutritional and hormonal regulation of hair follicle growth and development. Proc.Nutrition Society. 57:195-205.

Glinoer, D. (1997). The regulation of thyroid function in pregnancy: Pathways of endocrine adaptation from physiology to pathology. Endocrinology Rev. 18-404.

Hytten, F. and G. Chamberlain, (1980). Clinical physiology in obstetrics. Oxford, United Kingdom: Blackwell Scientific Publication,

Khan, S., (2007). Lactation- Reproduction interaction in Dairy Buffaloes. PhD Dissertation, NWFP Agricultural University, Peshawar, Pakistan.

Khan, S., M. S. Qureshi, N. Ahmad, M. Amjed, M. Younas, and A. Rahman. (2009). Feed supplementation prevents post-conception decline in milk progesterone concentrations associated with production stress in dairy buffaloes (Bubalus bubalis). Trop. Anim. Health Prod. 41:1133–1142

King, J. C. (2000). Physiology of Pregnancy and Nutrient Metabolism. American J. Clinical Nutrition. 71: 1218–25.

Kindahl H., B. Kornmatitsuk, K. Königsson, H. Gustafsson, (2002). Endocrine changes in late bovine pregnancy with special emphasis on fetal well-being. Domestic Animal Endicrinology. 23: 321-328

Lewis, L. D., (1995). Equine Clinical Nutrition: Feeding and Care, Williams and Wilkins, London.

Lynfield, Y. L. (1960). Effect of pregnancy on the human hair cycle. J Investigation dermatol. 35: 323–327.

Metwalli, O. M., S. I Salem, and S. L. Abdel-Razik. (1977). Effect of low-protein diet and its duration on hair composition. Zernahrungswiss.16: 241-47.

Mem, M. M. and N. G. Rubeiz. (2006). Physiological and biological skin changes in pregnancy.Clinical Dermatol. 24: 80–83.

Naismith D. J. (1973). Adaptations in the metabolism of protein during pregnancy and their nutritional implications.Nutrition Reprod. International.7: 383–99.

Nissimov, J. and U. Elchalal. (2003). Scalp hair diameter increases during pregnancy. Clinical Experimental Dermatol. 28: 525–530.

Okojie, F. O., Blessing, I. O., Mabel E. A., Okhiai .O., Unuabonah, F and Magdalene, D. (2011). Comparative study of lipid profile of normal pregnant women in the different trimesters. Arch. Appl. Sci. Res., 3:528-532.

Pan, Y. S. (1964). Variation in hair characters over the body in Sahiwal Zebu and Jersey cattle. Australian j. Agricu. Res. 5:346-356.

Pecoraro, V. and I. P. L. Astore. (1990). Measurements of hair growth under physiological conditions. In: Orfanos, CE, Happle, R, eds. Hair and Hair Diseases. Heidelberg: Springer; 237–54.

Randall, V. A. (2000). The biology of androgenetic alopecia. In: Camacho, F.M., Randall, V.A., Price VH, editors; pp123–36.

Slobodan, M and V. Snezana. (1998). The control of hair growth. Dermatology Online Journal, 4: 2.

Stenn, S. K. and Paus, R. (2001). Control of hair follicle cycling. Physio Rev. 8: 1- 47

Thornton, M. J., A. H. Taylor, K. Mulligan, F. Al-Azzawi, C. C. Lyon and J. O. Driscoll. (2003). The distribution of estrogen receptor beta is distinct to that of estrogen receptor alpha and the androgen receptor in human skin and the pilosebaceous unit. J. Invetigation dermatol. Symposium. 100–103.

van Beek N., Bodó E., Kromminga, A., Gáspár, E., Meyer, K., Zmijewski, M. A., Slominski, A., Wenzel, B. E., Paus, R. (2008). Thyroid hormones directly alter human hair follicle functions: anagen prolongation and stimulation of both hair matrix keratinocyte proliferation and hair pigmentation. J Clin Endocrinol Metab. 11: 4381-4388.

Wallace, M. L. and B. R. Smoller, (1998). Estrogen and progesterone receptors in androgenic alopecia versus alopecia areata. American J. Dermatopathology. 20: 160–163.